UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF COMMERCIAL FISHERIES

CALIFORNIA FISHERY MARKET NEWS MONTHLY SUMMARY

NOVEMBER 1969

PART II–Fishing Information*

Sea-surface temperatures, fishing and research information of interest to the West Coast tuna-fishing industry and marine scientists

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*Part I - "Fishery Products Production and Market Data" is issued by the Bureau of Commercial Fisheries, Market News Service, U. S. Custom House, Terminal Island, California

1969 PACIFIC COAST ALBACORE TUNA SEASON ENDS--EXCEPT IN CALIFORNIA WATERS

Fall weather settled in upon the Pacific Coast in October, causing virtually all fishing activity to be terminated in Washington and Oregon waters, but relatively good weather off central California has permitted a fleet of about 50 jigboats to continue fishing for albacore into the first week of December. Consequently, landings projections which were based upon a normal season closure at the end of October have been modified to reflect an improvement from below-average to average: production in California waters during October and November has added over 6 million pounds (3,000 tons) to Pacific Coast landings totals. At the present time, continued good weather favors additional production which may yet contribute 1/2 to 1 million pounds more to California totals during December. Thus, the 1969 season promises to tally between 48 and 49 million pounds (24,000-24,500 tons). Oregon and Washington again led the production race this year with about 34-1/2 million pounds (17,250 tons). California landings pulled up from an extremely poor start of 200,000 pounds (100 tons) in July to an estimated 11-1/2 to 12 million pounds (5,750-6,000 tons) when December totals are included; nevertheless, this late season finish will have failed to equal the 1968 season, thus making the 1969 season the worst on record in the state since 1942. British Columbia albacore landings totalled 2.4 million pounds (1,200 tons). Thus, despite heavy fishing effort again this year, the season's totals fell right on the 1963-68 average of 48 million pounds (24,000 tons).

For the third consecutive year, major dislocations in the centers of production were observed. We estimate that nearly one-half of the entire season's production originated from waters north of Cape Flattery and off Vancouver Island, and that less than 1/2 million pounds (250 tons) originated from the district south of San Juan Seamount. The farthest northward penetration of the commercial fishery was recorded this year: albacore were taken in the district northwest of the Dellwood Hills near 51°30' N latitude off the northwest corner of Vancouver Island. A few albacore were even taken inside Hecate Strait in late August.

We estimate that the fleet which fished albacore in 1969 was larger than usual. The regular albacore fleet was augmented by an appreciable number of Oregon, Washington and British Columbia salmon trollers, as well as a few halibut schooners. Total fishing effort is estimated to be higher than normal, and this year's middling catch was distributed more unevenly among the participants than last year. Furthermore, the 1969 season lasted appreciably longer

than in 1968, adding to production costs which were not offset by other factors. The train of events which led to these conclusions are briefly recapitulated in the summaries by month which follow:

JUNE

BCF R/V DAVID STARR JORDAN commenced trolling for albacore on June 9 while operating on the southern half of the California Cooperative Oceanic Fishery Investigations--Marine Life Research anchovy-sardine survey grid off Baja California. Despite JORDAN's presence on the usual early-season opening spots at a time when conditions were favorable for the early appearance of albacore, none were taken. The first authenticated catch of the season was reported by the fishing wessel TYPHOON operating about 450 miles west-southwest of Newport, Oregon on June 20. TYPHOON took 37 fish commencing on June 20 and intermittently thereafter up to June 30 in a region situated between longitudes 129° W and 135° W and latitudes 37° N and 41° N. TYPHOON was operating on a pre-season scouting trip under a cooperative arrangement between the Fishery-Oceanography Center and Oregon State University. Considerable nearshore scouting took place during the last week of the month off southern California, but only one 24-pound albacore was taken on June 29 by the sport-fishing partyboat HM-85 in 61° F water approximately 135 miles west-southwest of San Diego.

Unusual spring weather continued into June: the northwesterly winds on the eastern side of the North Pacific High were weaker than normal and the usual intensification of upwelling in May did not occur. Consequently, inshore temperatures were higher than normal, and the extent of the "green water" was much less than usual. A persistent cold-core eddy in the upper atmosphere virtually terminated normal northwesterly wind flow off central and southern California in the first 2 weeks of June, and sea temperatures began to rise sharply.

During the June 24-26 interval the Eastern North Pacific High began to intensify, bringing moderate to strong prevailing northwesterly winds to the entire U.S. west coast. Rain and overcast conditions, combined with turbulent wind mixing, caused sea surface temperatures to drop as much as 1.5° F in TYPHOON's operating area off Cape Mendocino and served to retard the normally-rapid advance of the 60-degree water northeastward. Thus, the warm sea temperature tongue which usually develops along an axis from 40° N, 130° W to Cape Blanco during the July 1-15 interval did not proceed as rapidly as in 1968, and consequently, we suggested that albacore would not enter the Oregon coastal zone in numbers until the second week of July.

Announcement of the fishermen-canners price settlement for the 1969 season was made on June 30, and many boats put to sea immediately.

JULY

Unverified reports of albacore catches off Coos Bay, Oregon were received on July 2. On July 3, the chartered fishing vessel SUNRISE, operating on an early-season scouting cruise for the Fish Commission of Oregon, reported their first catch about 120 miles off Brookings. In the second week of the month, fish were reported from below San Diego to the district off Coos Bay. Not until July 11 did high scores exceed 50-75 fish, and only then in the district from Fort Bragg north to Cape Blanco. The first fish of the season weighed in at 18-28 pounds. The early arrival of large fish, generally considered to be a "bad sign," caused widespread concern because the incoming size class, 10-15 pounds, often comprises up to one-half of the total annual production each year. The first occurrence of 13-pound fish was reported from the northern fishing grounds on July 14.

Prevailing weather north of Cape Blanco continued literally to dampen prospects for a warm season--overcast skies, rain and windy weather associated with rapidly-moving surface lows dominated the weather scene for the first 2 weeks of the month, sharply limiting the rate of advance of the 60° F isotherm toward the Oregon coastline. Concurrent with accelerated northerly wind flow off northern and central California, the first major upwelling pulses of the season were observed in the July 1-15 interval.

Albacore fishing activity gained speed steadily during the last 2 weeks of the month, but events indicated that the development of the fishery lagged about 2-3 weeks behind 1968. Commercial-scale fishing (more than 100 fish per boat per day) was not widespread until the July 15-21 interval, when the first major center of activity developed off Coos Bay, Oregon. Subsequently another center developed off Point Conception, where about 50 boats had assembled. During the last week, the good fishing area off Coos Bay dwindled sharply, and a new area appeared to be developing about 100-120 miles west of Cape Shoalwater, Washington.

In the second half of July, the Eastern North Pacific High was more intense than average, and its mean position was displaced to the north of its usual position. Increasing pressures offshore and continuing high temperatures inland brought strong to very strong northwesterly winds from Cape Blanco south to Point Conception. Winds from 30-50 knots were observed off Oregon and northern California on July 22-23, and the resultant heavy seas caused damage to several vessels off southern Oregon. Two boats--TROJAN and COMPASS STAR were reported as missing; the U.S. Coast Guard instituted search proceedings for both vessels, but failed to find either one.

AUGUST

Although the pace of albacore fishing activity accelerated in early August, U.S. west coast fishermen started bracing for a tough production year. Landings reflected the slow pace of production: many boats were coming to port with

partial fares, and no major concentrations of fish were located. Landings in southern California were still among the poorest on record, whereas in Oregon, even though landings were above the long-term average, the totals continued to rise slowly.

No major fish concentrations were reported during the first half of the month, but albacore were found ranging over a very large district offshore from Cape Blanco to the area west of Vancouver Island. Jigboats did not fare as well as last year at this time; they reported their total catches as significantly off from last year's totals. The pace of baitboat activity began to accelerate in the second week, and they reported production was ahead of last year at the same time. A small fleet continued operating in the southern California offshore zone, but adverse weather conditions kept production below last year's level.

In the first 2 weeks of August, weather generally was good in the district north of Cape Blanco. Farther south, from Cape Mendocino to Point Conception, the weather was "sloppy." Except for slack intervals between prolonged windy periods, the entire district was too rough to fish: wind velocities averaged 25-30 knots and sea heights ranged from 8-14 feet over most of the interval. South of Point Conception, winds and seas were generally workable.

Fishing activity finally reached peak levels during the second half of the month. Excellent fishing developed off the southwest coast of Vancouver Island in the third week, and the center of activity then moved quickly northwestward. Weather conditions were good during the interval, and many boats reported averaging 200-400 fish per day during a 15-20 day period. The district 40-60 miles off the Washington coast also yielded excellent catches, and until the squally weather on August 23-24, when the baitboat THREE HAWKS capsized and sank, good scores prevailed.

Weather conditions were generally good to excellent in the district from Cape Blanco to Cape Flattery in the second half of the month. A rapidly-moving frontal system entered British Columbia on August 23-24, spreading havoc among boats operating off Vancouver Island; however, this storm system did not seriously affect operations south of Grays Harbor, Washington. Normal late summer intensification of the thermal trough over interior valleys and deserts in California generated strong to very strong northwesterly winds off central and northern California during the period; consequently, fishing operations were severely restricted in this district as strong winds and heavy seas continued into the fifth consecutive week without letup.

Upwelling and turbulent mixing increased significantly during August 1-15 off California, and it appeared as if the peak of the summer warming cycle had been reached. In the second half of the month, sea surface temperatures commenced to decline near shore in the area north of the Columbia River. Heat loss to the atmosphere began to accelerate and was expected to increase during the

first half of September. The fleet reported that fishing was becoming more spotty as albacore schools began to break up and become harder to locate, and many boats began to move south to fish in southern Oregon and northern California waters where albacore were relatively abundant and accessible in better weather. California landings totals recorded an influx of over 300 tons into Eureka during the pre-Labor Day weekend.

SEPTEMBER

By early September, it was evident that the 1969 albacore season had fallen substantially behind 1968 production levels. U.S. west coast landings were estimated to total about 27-29 million pounds (13,500-14,500 tons) by mid-September, or about 6-8 million pounds (3,000-4,000 tons) behind last year. Oregon-Washington landings comprised about 24-25 million pounds (12,000-12,500 tons), slightly below those of last year. California landings amounted to only 3-4 million pounds (1,500-2,000 tons). The landings outlook for Oregon and Washington began to look poor for the remainder of the 1969 season. Deliveries to Pacific Northwest ports reflected a sharp drop in production in northern waters during the second week. Production in Oregon and Washington was expected to level off between 26 and 30 million pounds (13,000-15,000 tons) for the season. California landings, still among the poorest on record, began to improve in September. The center of fishing activity shifted southward, and landings picked up in northern and central California ports. Many California boats fishing in Pacific Northwest waters started to return home with partial fares, thus adding appreciably to season totals.

Fishing conditions on the northern grounds favored baitboats in the first 2 weeks of the month. These boats reported a few scores of 500-1,000 fish per day; nevertheless, fishing stops were reported as being very short on small, fast-moving schools. Jigboats experienced poor fishing for the third consecutive week. Few scores above 200 fish per day were reported from all districts, and the rule was about 100 fish per day in the north and 40-80 per day in the south.

Weather conditions began to deteriorate in the first half of September. Fog and rain associated with several Gulf of Alaska storm systems hampered operations off Vancouver Island. Washington weather cleared near the end of the first week, permitting the fleet to return briefly to the northern grounds. In southern Oregon and northern California, persistent northwesterly winds from 25-35 knots continued to lash the area. Winds and seas began to moderate off central and southern California allowing renewed fishing efforts in these regions.

Fishing activity dropped off sharply during the second half of September in Oregon and Washington as a series of early fall storms began entering the Pacific Northwest on September 16-17. Fishing terminated completely off Vancouver Island and Washington early in the third week of the month, whereas

in Oregon, a few baitboats remained in a small area between Cascade Head and Newport before coming south. Some baitboats resumed limited fishing activity near shore as far north as the Columbia River when the weather improved after September 25. Weather conditions also improved in northern and central California, and a major center of activity developed off Fort Bragg and Point Arena subsequent to the passage of R/V DAVID STARR JORDAN on September 15 and 16. Here a large area of school fish was discovered from 80-160 miles offshore. Catches in the period commencing on September 16 and ending on September 26 ranged from 100 fish per day to over 1,000 fish per day for a large fleet of jigboats; two baitboats reporting from this district each had tallied 2,000-fish scores for 2 consecutive days around September 18 and 19. In southern California, catches remained poor, but scattered activity was reported by sportboats off San Diego and by commercial boats from Rodriguez Dome to an area 40-50 miles off Morro Bay.

Sea surface temperatures cooled slightly from the August 16-31 peak, and most areas remained cooler than the 9-year normal. The September 1-15 sea surface temperature chart was considerably cooler than the same one of last year, especially off the Pacific Northwest. Temperatures continued to fall in the Pacific Northwest region as strong winds and turbulent mixing prevailed in the latter half of the month. The 60° F isotherm moved rapidly southwestward in the area north of the Columbia River, whereas to the south, brisk winds caused an upwelled zone to increase in breadth from Cape Blanco to the Oregon-California border, causing the 60° F isotherm to be moved offshore approximately 40-60 miles. Slack winds in northern and central California offshore regions resulted in cessation of intense upwelling in this area, and the warm oceanic water slipped rapidly coastward, permitting albacore to move close to shore.

OCTOBER

Continued cooling of the upper mixed layer of the sea in all areas north of Cape Mendocino was observed. A series of storms entered the Pacific Northwest at frequent intervals, causing virtually all fishing activity in Washington and Oregon to be terminated by the week ending October 24. However, October weather was generally better this year than last. The fall storms in the Pacific Northwest came gradually, forcing the tuna fleet progressively southward as the offshore area cooled north of Cape Blanco. Strong southwesterly winds spread as far south as San Francisco, and calm to variable wind conditions prevailed during most of the last 2 weeks off central California. The good weather off central California permitted a fleet of more than 50 jigboats to continue fishing for albacore right up to the end of the month. The most productive area was situated from 60-150 miles offshore from Point Sur to Point Conception. Daily scores reported from this area hovered slightly below 100 fish on the average, but a few scores of 250-300 fish were tallied.

The unexpected appearance of commercial quantities of albacore off central California in October substantially altered an otherwise disappointing season. We estimated that the October production from this district would contribute approximately 5 million pounds to the season totals, and that the bulk of the catch would be unloaded in California ports.

Issuance of Bulletin No. 69-10 on October 31 marked the scheduled close of our albacore fishery monitoring and prediction activities for 1969, despite the fact that good fishing was continuing into November off central California. Daily radio advisory broadcasts were terminated, but we continued to maintain intermittent contact with fishermen at sea, as well as dock operators and processors.

NOVEMBER

Although this month usually observes the termination of the season off California, this year was an exception. Strong winds and rough seas during the first week of the month forced most of the boats into Monterey and Morro Bay. In the second week, restoration of the Great Basin High created light easterly to calm winds (except for Santa Ana winds in the vicinity of canyons near shore) which dominated the weather scene for the rest of the month. Smooth seas and good visibilities permitted about 50 boats to stay on the fish almost continuously in an area 30-50 miles offshore from San Simeon to Point Conception. Although we had predicted that the optimum temperature zone would commence moving offshore in this region early in November, making the albacore harder to reach, such was not the case. Slack winds caused virtual termination of the usual upwelling, permitting the warm oceanic water to slip in close to shore, and allowing the albacore to remain in very rich feeding grounds. Some large albacore to 40 pounds were reported off San Nicolas Island early in the month. Average scores hovered between 25-80 fish per day for most boats for the remainder of the month, and a Thanksgiving Day surge of activity brought a reported top score of 225 fish. However, few complaints were voiced by fishermen at these low catch rates, because the high average weight per fish (more than 20 pounds) permitted attainment of a 1-ton-per-day objective within easy reach of several California ports. Over 1 million pounds (500 tons) were delivered in California, and an additional 1/2 million pounds (250 tons) was estimated to remain at sea. Favorable water temperatures continued right up to the end of the month as the Great Basin High and intermittent Santa Ana weather persisted into the fourth consecutive week.

DECEMBER

At a time when most fishermen are in port, an estimated 40-50 boats continue to operate off central California. Large fish are still present in an extensive area from Rodriguez Dome north to San Simeon. Average catches are hovering near 1/2 ton per day for most boats, virtually assuring at least

1/2 million pounds (250 tons) of production will be delivered in California during December. Thus, our outlook statements issued on September 1 have remained valid through the entire October-December interval: those fishermen who have stayed with the albacore as long as good weather has prevailed are those most likely to pull off a decent production year.

Finally, for the fishermen, it was a tough year. All boats operated under more difficult weather conditions--and longer--this year. The total working season in 1969 included 153 days between July 1 and December 1; of this total, an estimated 28 days well may have been lost on account of high winds and heavy seas, leaving an effective season of about 125 working days. Few dockside delays were reported this year; all processors were prepared for the rush in the Pacific Northwest, and handled unloading expeditiously.

The 1969 season was primarily a jigboat year. Nevertheless, no outstanding scores were reported, and good spurts of action were few and far between. Baitboats fared well only in brief flurries late in the season; their problems were aggravated by rough seas and fast-moving, small schools. Bait was generally available, and no major shortages were reported. Altogether, small boats fared worse than large boats--the rich Vancouver Island offshore fishery was too remote for them to take advantage of it. Ice boats fared poorer than refrigerated boats--short trips to port were followed by protracted running periods just to return to the fast-moving fish. The Pacific Northwest fleet generally fared better than the small boat fleet from California, but many exceptions were noted. Thus, for many operators, higher costs were incurred to produce an equivalent amount of fish. These costs were not completely offset by the dockside price of $450 per ton delivered to Astoria, Oregon, and southern California ports.

In summary, the 1969 production year was middling at best: the late fall pullout off California permitted the fishing industry barely to meet the 1963-68 production average, despite a group of circumstances which should have favored a better season than was realized.

Pre- and mid-season scouting surveys were the most timely and comprehensive ever to be provided by state and federal agencies. The Bureau of Commercial Fisheries R/V DAVID STARR JORDAN surveyed the southern region in early June and then the entire Pacific Northwest area from mid-August to mid-September. Oregon State University staged several surveys in Oregon offshore waters both before, during, and after the season on R/V YAQUINA and CAYUSE. The Fish Commission of Oregon also staged their annual early-season survey of Oregon waters aboard the fishing vessel SUNRISE commencing on June 30 and ending on July 11. Altogether, the industry had available to them this year a record amount of information on which to base decisions while at sea and ashore.

Review of our annual forecast statement and bulletins has shown that the advisory materials available to the fleet this year were the best yet provided. Both our La Jolla Laboratory and the Oregon State University Sea Grant Albacore Central contributed to this advisory data base.

Our estimates of early season warming were first issued in the April 30 bulletin and further reported in later bulletins. The early arrival of the albacore did not materialize as expected in southern California, but came close to the mark in the north. We reported the temporary cooling of the Cape Mendocino offshore district in late June, and our adjustment of the estimated date of the opening of the Oregon fishery was later validated by events in that area. The extreme northward penetration of the fishery was not expected--but the historical record also showed no other comparable situation. Intensification of upwelling off northern California and southern Oregon in July through mid-September forced the fishermen to make a difficult choice: either remain in southern California and "tough it out" or move to Washington and Vancouver Island and compete with the crowd already there.

July landings in California were about as forecast, but Oregon production was slower than expected because of the late start and rough weather at the beginning. We correctly predicted that most early season fish that were taken in California waters would be delivered to Astoria as the fleet moved to the north.

The Guadalupe Island area remained much cooler than our June 10 forecast statements had expected, but this was due to the downstream entrainment of cold water from the very intense upwelling zone to the north. Our estimate of total production given on June 10 hit the mark squarely, but this forecast was saved only by the October-November pullout mentioned above. California landings failed to meet our expectations, but Oregon and Washington landings projections hit near to the mark.

Thus, our advisory services scored well despite all these unforeseeable events. What our experience continues to show is that we need further to expand and refine our data acquisition, monitoring, interpretation and dissemination systems so that we may properly synthesize and interpret the complex chain of events occurring each year. Continual reevaluation of all advisory statements, and updating and corrections thereto is absolutely necessary. Several of our bulletins contained appropriate revisions as trends suddenly changed. The real-time information from JORDAN's survey of the entire albacore production district was exceptionally useful this year in permitting us to gauge, and to report while on the grounds, the character of the entire season.

Your comments and suggestions for improving our program in 1970 are solicited. Next year's schedule of activities will be announced in the April 1970 issue of this publication

December 9, 1969

Glenn A. Flittner, Leader
Fishery-Oceanography Group

* * * * * * * * * *

NEW CHARTS PRESENTED FOR READERS APPROVAL

Plates 1 and 2 are examples of the type of additional charts, analyzed from observed marine synoptic weather data, that can be provided each month in this publication by the Fishery-Oceanography Group.

Plate 1 shows the 9-year mean values for November of barometric pressure (millibars), resultant wind direction (denoted by the arrows) and wind speed, averaged regardless of direction (number in center of arrow in knots). These values have been computed for all synoptic weather reports falling within each of the 5° latitude-longitude quadrangles, and the chart depicts the large-scale features of variables. Plate 2 shows the same set of variables for November 1969, and points out features that were particular for that month--and also that these features differ in many ways from those of the 9-year mean chart. Note that in both charts the resultant wind arrows (computed by averaging all of the north-south, then east-west components of the observed wind velocity and then obtaining a direction in degrees true) generally lie along or slightly off the lines of equal surface pressure (isobars). In some areas this is not the case and can be attributed to: 1) atmospheric conditions other than the pressure distribution affecting the wind direction; 2) coastline effects; and 3) the occurrence of faulty reports.

The November 1969 data differ from those of the 9-year mean for November in two ways:

1. The surface pressure distribution in the area between Hawaii and the Aleutian Island chain is lower than that of the 9-year mean and the average wind speeds are also greater. This indicates that a greater number of storm systems (cyclones) moved through this area during the month than in other years.

2. Off the U.S. west coast, the northeast portion of the high pressure distribution in the subtropical latitudes was displaced farther to the north than in the mean chart. This setup, in conjunction with Santa Ana conditions that

prevailed during much of November, caused the winds along the central and southern California coasts to be weaker than the mean. The tendency of the winds to blow offshore from the north-northeast, contributed to the good fishing conditions off central California (as described in the fishing season summary article in this issue).

We would appreciate your comments on the utility of these charts in this publication. If enough requests are received, the charts will be incorporated on a regular basis beginning in January 1970. Replies should be mailed to:

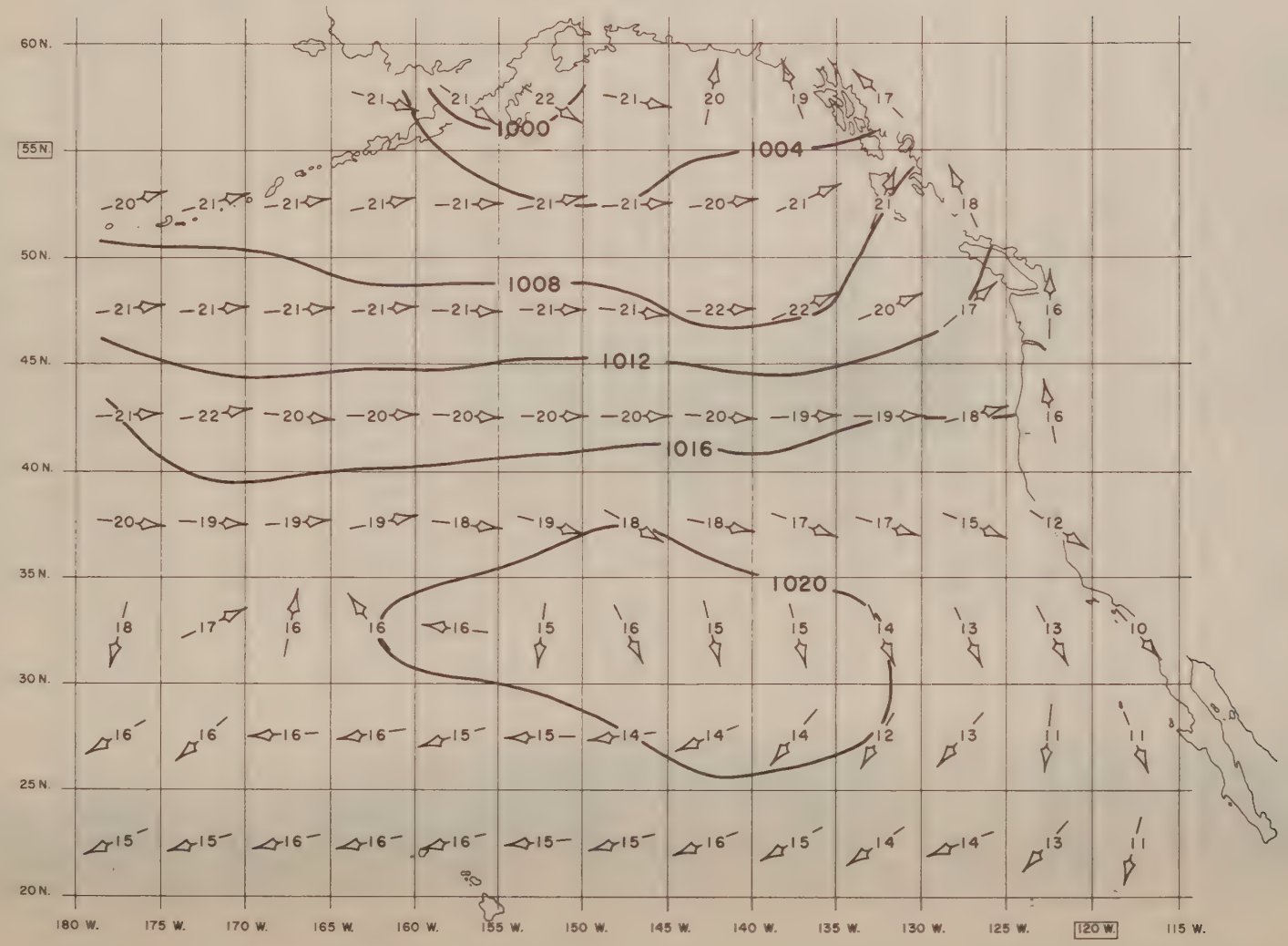
Director
Bureau of Commercial Fisheries
Fishery-Oceanography Center
P.O. Box 271
La Jolla, California 92037
Attention: Fishery-Oceanography Group

NOVEMBER 1961-1969

PLATE I.-OBSERVED MEAN VALUES

—0000— ISOBARS OR LINES OF CONSTANT BAROMETRIC PRESSURE (MILLIBARS).

No. RESULTANT WIND DIRECTION (ARROW) AND AVERAGE WIND SPEED REGARDLESS OF DIRECTION (No.).

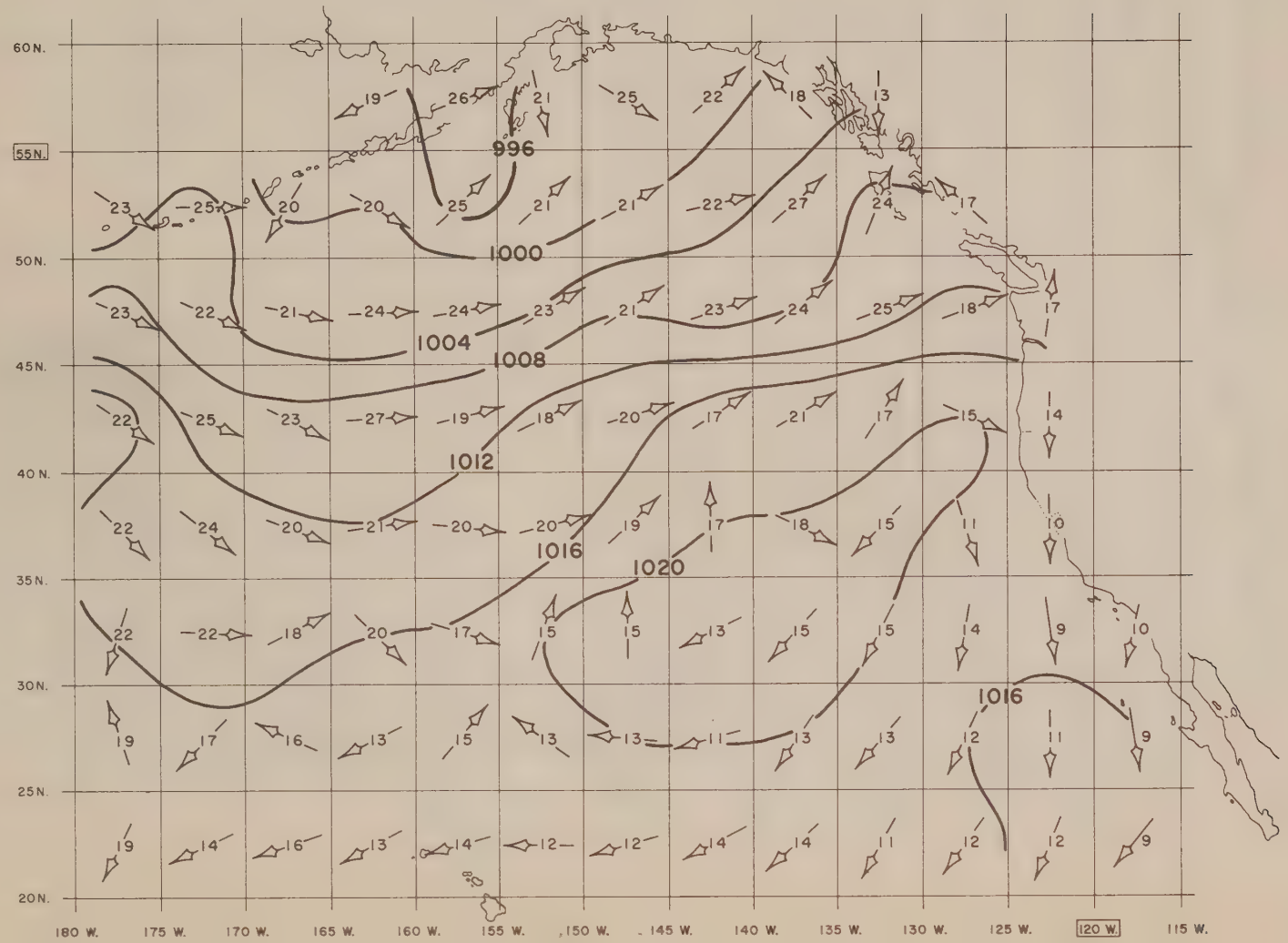


NOVEMBER 1-30, 1969

PLATE 2.-OBSERVED VALUES

—0000— ISOBARS OR LINES OF CONSTANT BAROMETRIC PRESSURE (MILLIBARS).

No. RESULTANT WIND DIRECTION (ARROW) AND AVERAGE WIND SPEED REGARDLESS OF DIRECTION (No.).



SEA SURFACE TEMPERATURE CHARTS, EASTERN PACIFIC OCEAN
NOVEMBER 1969

Acknowledgements

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U.S. Bureau of Commercial Fisheries Biological Laboratories La Jolla, California, Honolulu, Hawaii and Seattle, Washington
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Environmental Science Services Administration
U.S. Weather Bureau, San Diego, California
U.S. Coast and Geodetic Survey, Pacific Marine Center, Seattle, Washington
General Dynamics Convair Division; Ocean Data Buoy ALPHA
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Inter-American Tropical Tuna Commission, La Jolla, California
Inter-American Geodetic Survey by R. and L. Peren at Puerto Armuelles, Panama; D. Chaves at Talara, Peru; E. Portocarrero at San Juan, Peru
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Matson Navigation Company, San Francisco, California; S. S. CALIFORNIAN
Pacific Missile Range, Range Operations Department, Geophysics Division Point Mugu, California
Pacific Oceanographic Group, Nanaimo, British Columbia, by H. J. Hollister from observations by G. C. Wilks at Langara Island Light; R. W. Pigott at Cape St. James Light; Lily Collins at Kains Island Lightstation; O. A. Edwards at Amphitrite Point Light
Scripps Institution of Oceanography, La Jolla, California, by Margaret Robinson
Scripps Institution of Oceanography Research Vessels ALEXANDER AGASSIZ, THOMAS WASHINGTON, ARGO, FLIP, MELVILLE

Charts

Figure 1.--Mean sea surface temperature (° F) derived from approximately 8000 observations. Squares show temperatures at weather ship stations. Numerals on shore are temperatures at coastal and lightship stations.

Figure 2.--Deviation of sea surface temperatures (° F) from long term charts of H. O. 225. Hatched areas are colder in 1969.

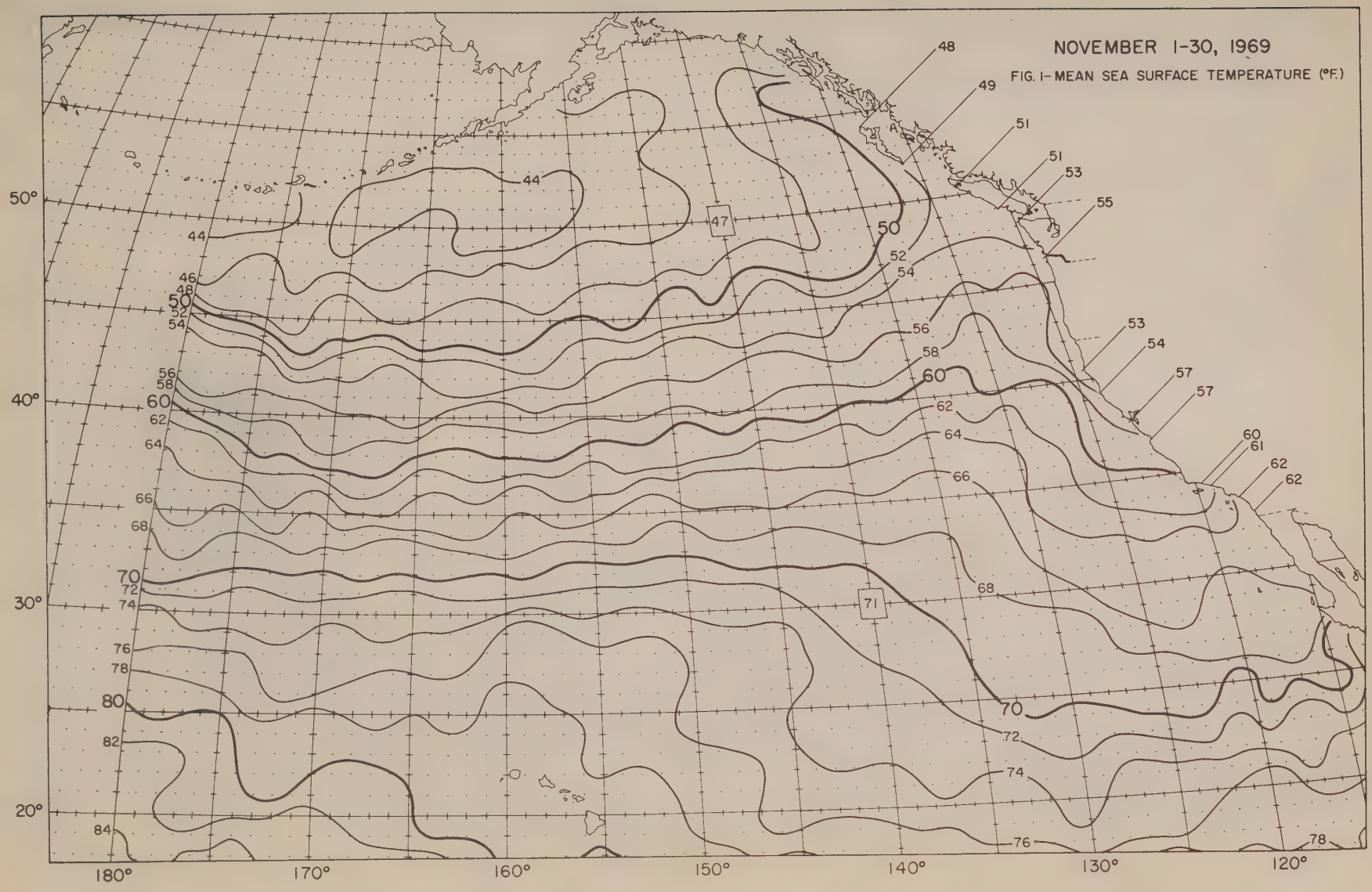
Figure 3.--Deviation of sea surface temperatures (° F) from those of November 1968. Hatched areas are colder in 1969.

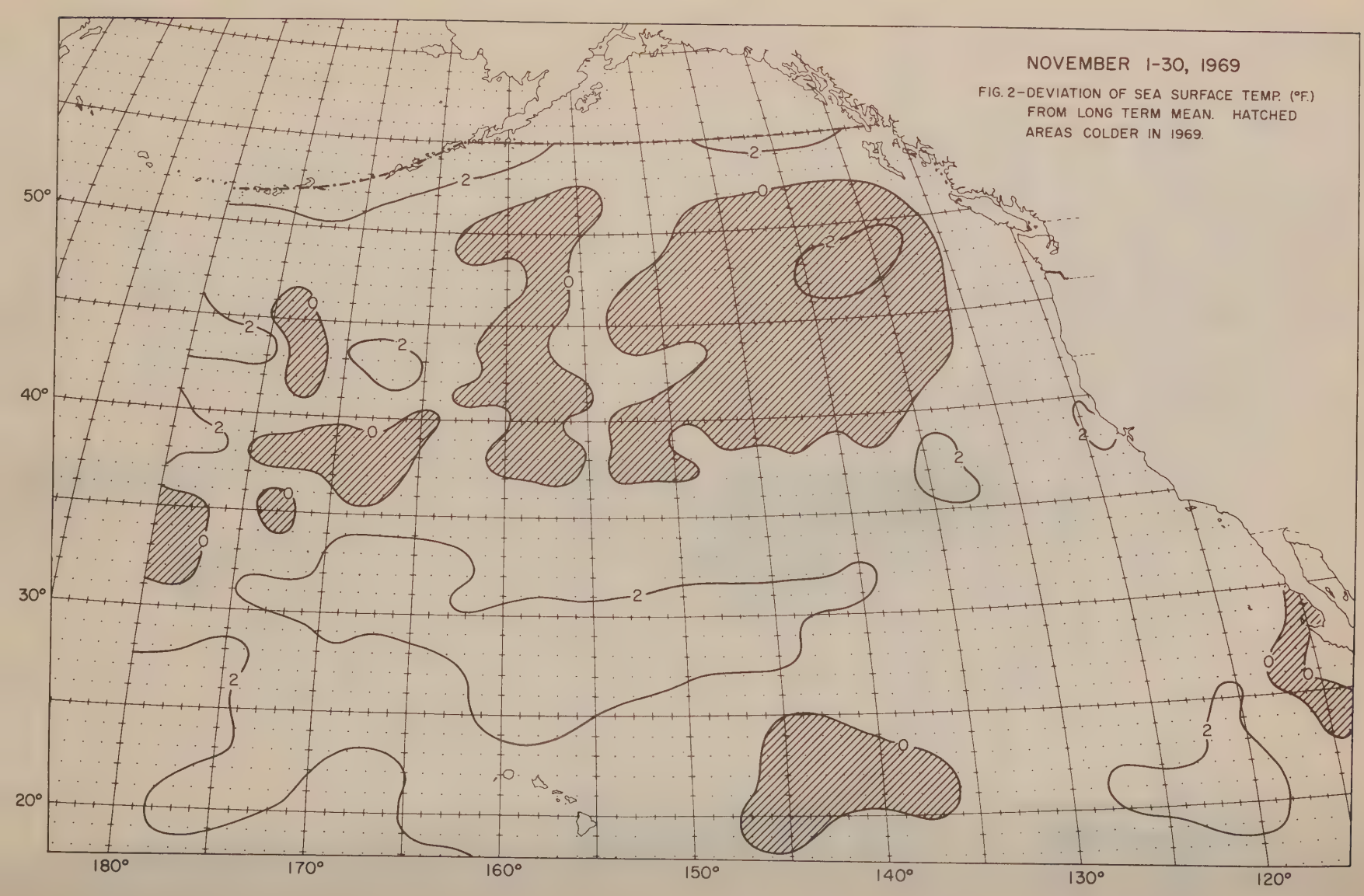
Figure 4.--Sea surface temperatures (° F) by 1-degree squares, approximately 2000 observations. Line under temperatures indicates average of two or more observations. Numerals on shore are temperatures at coastal stations.

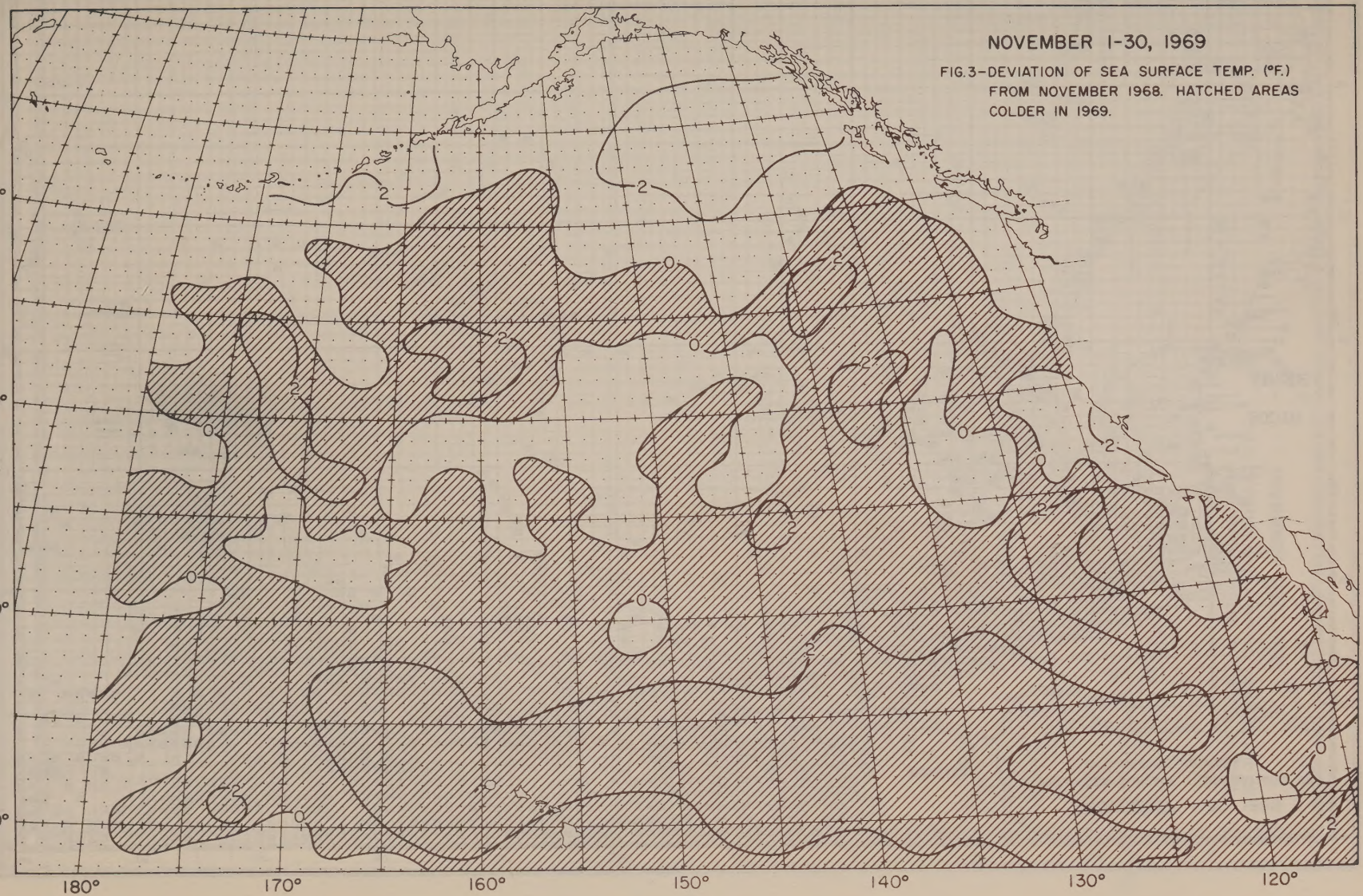
Figure 5.--Deviation of sea surface temperatures (° F) November 1969-November 1968 by 1-degree squares. Shaded areas are colder in 1969.

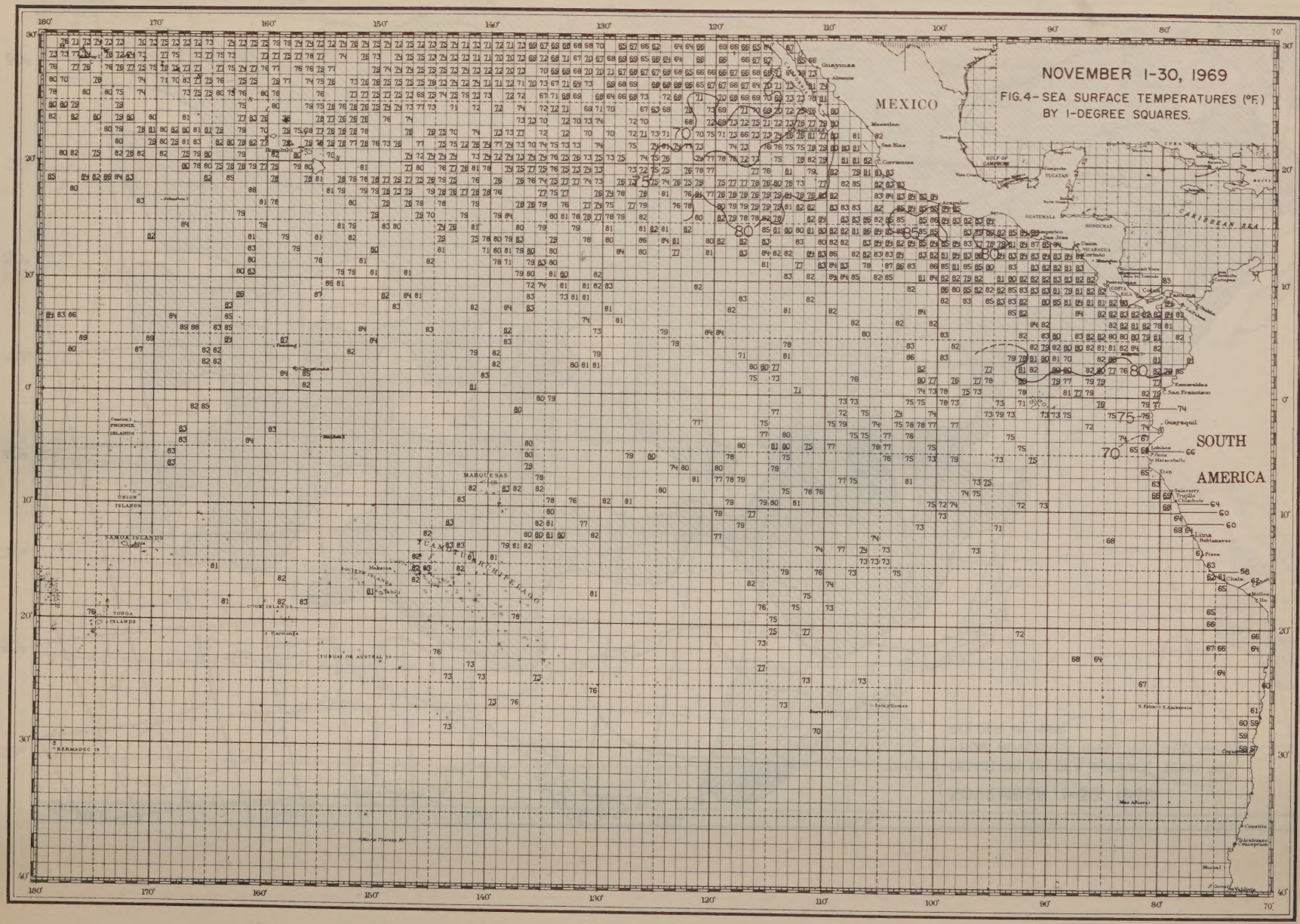
Figure 6.--Deviation of sea surface temperatures (° F) from 12-year mean (1947-1958) by 2-degree squares. Shaded areas are colder in 1969.

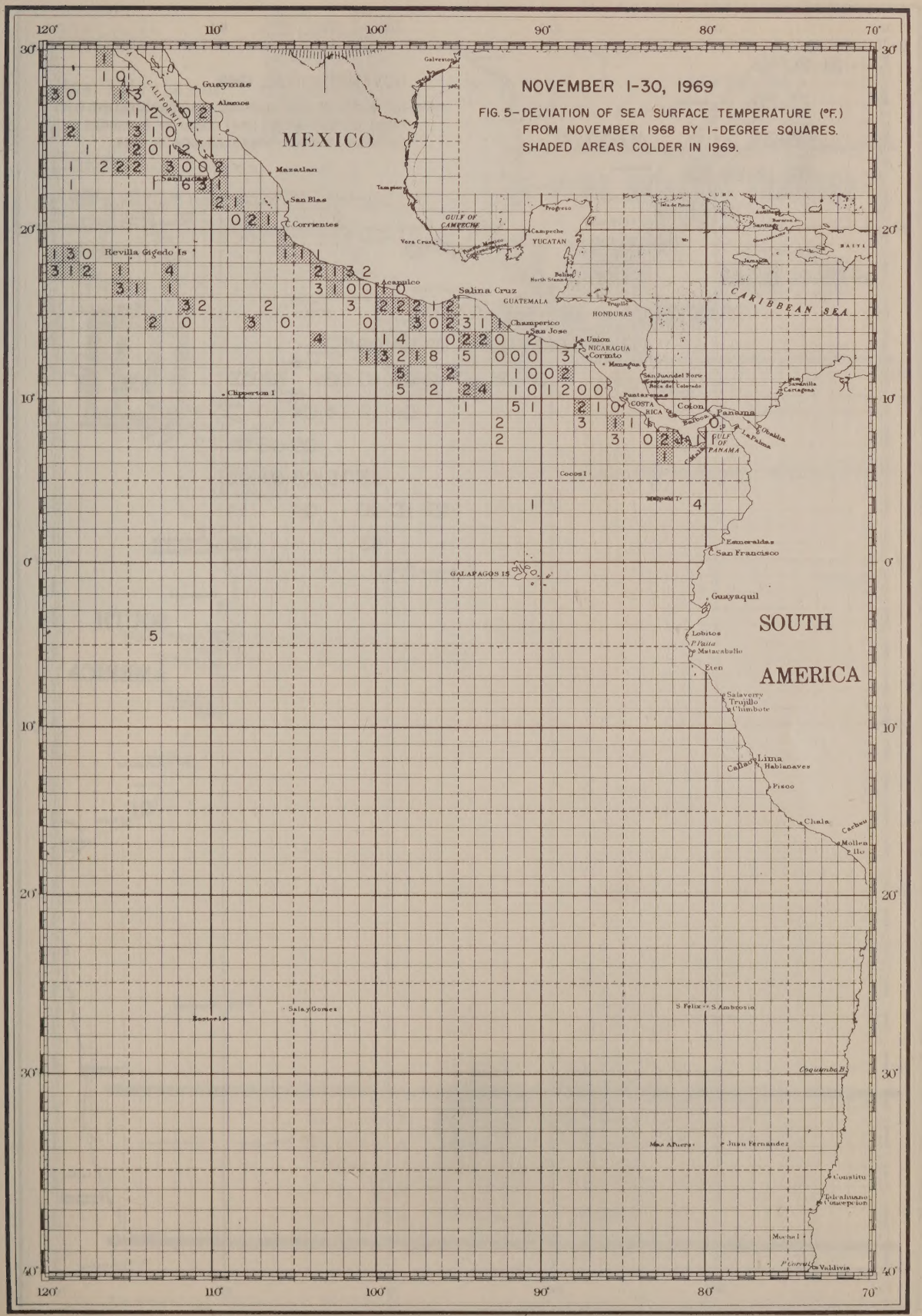
James A. Renner, Fishery Biologist
Kenneth S. Raymond, Scientific Illustrator
December 8, 1969

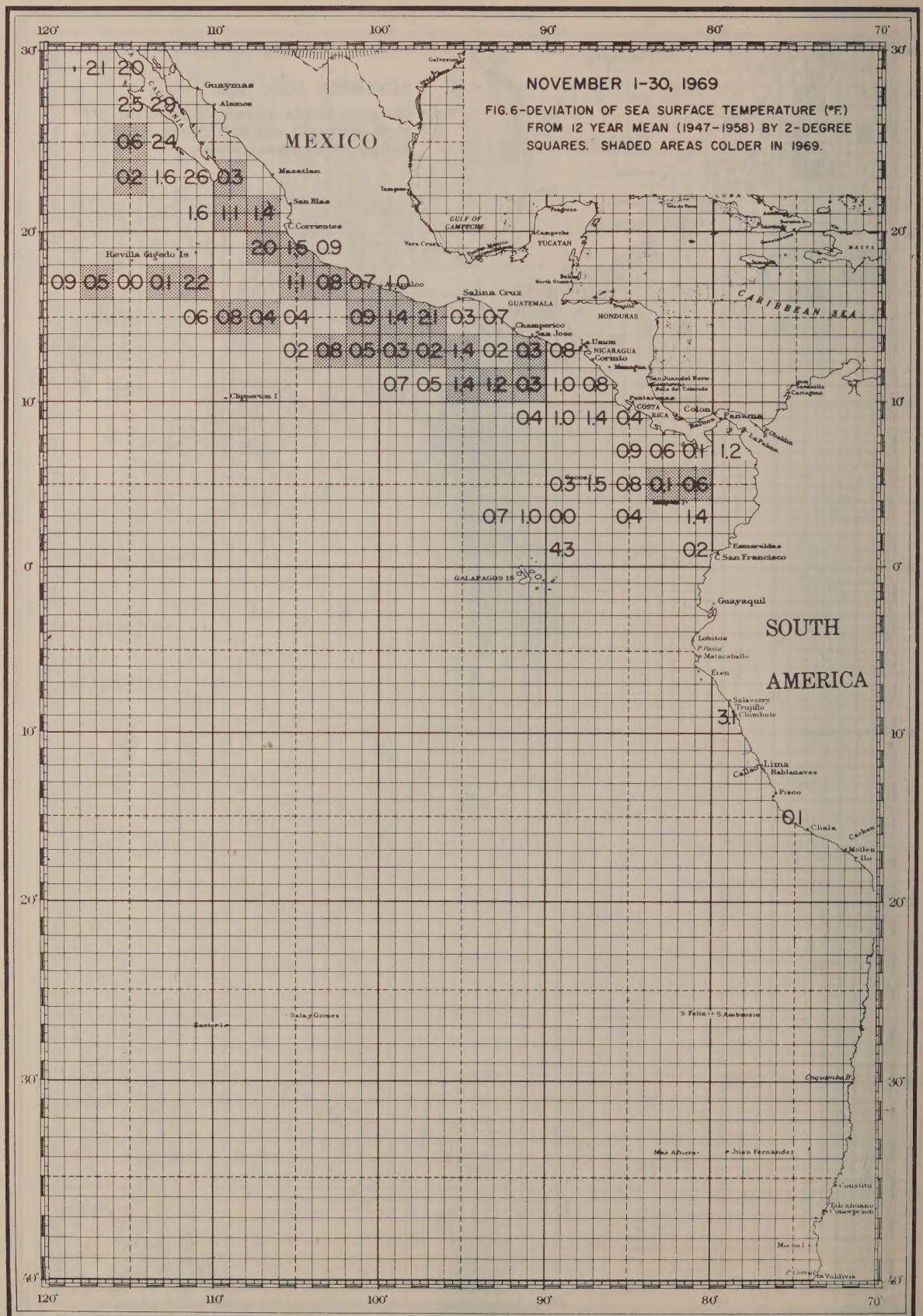

NOVEMBER 1-30, 1969
FIG. 1- MEAN SEA SURFACE TEMPERATURE (°F.)
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°
47
71


NOVEMBER 1-30, 1969
FIG. 2-DEVIATION OF SEA SURFACE TEMP. (°F.) FROM LONG TERM MEAN. HATCHED AREAS COLDER IN 1969.
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°
0
2


NOVEMBER 1-30, 1969
FIG.3-DEVIATION OF SEA SURFACE TEMP. (°F.) FROM NOVEMBER 1968. HATCHED AREAS COLDER IN 1969.
50°
40°
30°
20°
180°
170°
160°
150°
140°
130°
120°


NOVEMBER 1-30, 1969
FIG.4- SEA SURFACE TEMPERATURES (°F.)
BY 1-DEGREE SQUARES.
MEXICO
SOUTH
AMERICA
CARIBBEAN SEA
GUATEMALA
HONDURAS
NICARAGUA
COSTA RICA
PANAMA
CUBA
YUCATAN
GULF OF CAMPECHE
Guaymas
Mazatlan
San Blas
Corrientes
Manzanillo
Acapulco
Salina Cruz
Puerto Angel
Champerico
San Jose
Corinto
Managua
Cocos I.
Balboa
Panama
Galapagos Is.
Guayaquil
Salaverry
Trujillo
Chimbote
Lobitos
Talara
Mancora
Eten
Callao
Lima
Pisco
Chala
Mollendo
Ilo
Arica
Iquique
Tocopilla
Antofagasta
Chanaral
Coquimbo
Valparaiso
Talcahuano
Concepcion
Corral
Mocha I.
Juan Fernandez Is.
Easter I.
Sala y Gomez
San Felix
San Ambrosio
Mas Afuera
Mas Atierra
Callao
Chimbote
Salaverry
Trujillo
Chiclayo
Talara
Lobitos
Eten


NOVEMBER 1-30, 1969
FIG. 5-DEVIATION OF SEA SURFACE TEMPERATURE (°F.) FROM NOVEMBER 1968 BY 1-DEGREE SQUARES. SHADED AREAS COLDER IN 1969.
MEXICO
SOUTH AMERICA
CARIBBEAN SEA
GULF OF CAMPECHE
GULF OF PANAMA
CALIFORNIA
GUATEMALA
HONDURAS
NICARAGUA
COSTA RICA
YUCATAN
CUBA
HAITI
JAMAICA
Guaymas
Alamos
Mazatlan
San Blas
Corrientes
Revilla Gigedo Is
Acapulco
Salina Cruz
Champerico
San Jose
Corinto
Managua
Panama
Colon
Chipperton I
Cocos I
Galapagos Is
Esmeraldas
San Francisco
Guayaquil
Lobitos
Talara
Paita
Mataracbullo
Eten
Salaverry
Trujillo
Chimbote
Lima
Callao
Hablanaves
Pisco
Chala
Cachen
Mollen
Ilo
Salaverry
Easter Is
S. Felix
S. Ambrosio
Juan Fernandez
Mas Afuera
Valdivia
Corral
Mocha I.
Concepcion
Talcahuano
Constitu
Coquimbo
Progreso
Campeche
Vera Cruz
Tampico
Galveston
Trujillo
Bahia
North Stream
Barranquilla
Cartagena
Puntarenas
Bahia de Panama
La Palma
La Ondalia
Rio de Piedras
Aguadilla
Arecibo
Barranquitas
Guayama
Santiago
Jamaica
Bahia de Pinos
San Juan del Norte
Bluefields
Rama
Bluff
Cabo Gracias a Dios
Rio Grande de Colorado


NOVEMBER 1-30, 1969
FIG. 6-DEVIATION OF SEA SURFACE TEMPERATURE (°F.) FROM 12 YEAR MEAN (1947-1958) BY 2-DEGREE SQUARES. SHADED AREAS COLDER IN 1969.
MEXICO
SOUTH AMERICA
CARIBBEAN SEA
GULF OF CAMPECHE
GUATEMALA
HONDURAS
NICARAGUA
COSTA RICA
GALAPAGOS IS
Guaymas
Alamos
Mazatlan
San Blas
Corrientes
Revilla Gigedo Is
Salina Cruz
Champerico
San Jose
Chipperton I
Galveston
Tampico
Vera Cruz
Progreso
Campeche
YUCATAN
Belize
Trujillo
Colon
Panama
Cartagena
Guayaquil
Lobitos
P Pata
Matacabello
Eten
Salaverry
Trujillo
Chimbote
Lima
Callao
Hablanaves
Pisco
Chala
Caldera
Mollendo
Arica
Esterio
Sala y Gomes
S Felix
S Ambrosio
Juan Fernandez
Mas A Fuera
Constitu
Talcahuano
Concepcion
Valdivia
Corcovado G
Quiriquina B
Coquimbo B